When smiles (and frowns) speak words: Does power impact the correspondence between self-reported affect and facial expressions?

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Abstract

Self-reported experiences are often poor indicators of outward expressions. Here we examine social power as a variable that may impact the relationship between self-reported affect and facial expressions. Earlier studies addressing this issue were limited by focusing on a single facial expression (smiling) and by using different, less sensitive methods that yielded mostly null results. Sampling, for the first time, self-reported affect repeatedly in response to different negative, neutral and positive stimuli, and measuring concurrent facial muscle activation via electromyography, we found that high power (*vs.* baseline) increased the correspondence between self-reported positive affect and smiling. There was also an indication that high power (*vs.* baseline) bolstered the association between self-reported negative affect and frowning but the effect did not pass more stringent criteria for significance ($p \leq .005$) and was therefore deemed inconclusive. The prediction that low power (*vs.* baseline) decreases the correspondence between self-reported affect and smiling and frowning facial expressions was not supported. Taken together, it would appear that (high) power can impact the relationship between self-reported affect and facial expressions, but it remains to be seen whether this effect extends beyond smiling facial expressions.

Keywords: power, facial expression, affect, electromyography

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Internal feelings do not always correspond to outward expressions. This dissociation is exemplified by the tenuous relationship between self-reported affect and facial expressions (e.g., Reisenzein, Studtmann, & Horstmann, 2013). Although the extant literature provides some clues as to why these dissociations exist (e.g., Durán, Reisenzein, & Fernández-Dols, 2017), the role of social variables in these effects remains relatively unexplored. Here, we consider whether social power impacts the correspondence between self-reported affect and facial expressions. We focus on smiles and frowns as relatively unambiguous expressions that can be mapped onto clearly defined affective states (Ekman & Friesen, 1969; Reisenzein et al., 2013). As such, the present research examines whether elevated power may strengthen, and impaired power disrupt, the association between self-reported affect, and smiling and frowning facial expressions.

To say that we smile when happy and frown when sad is seemingly uncontroversial, and implies that affective experiences can be reliably mapped onto facial expressions. Indeed, prominent theoretical perspectives argue that experiences and expressions reliably co-occur and form functionally adaptive programmes (e.g., Ekman, 1992; Hollenstein & Lanteigne, 2014; Lazarus, 1991; Levenson, 2014; Mauss, McCarter, Levenson, Wilhelm, & Gross, 2005; but see also Barrett, 2006). This phenomenon falls under the broader umbrella of emotion coherence (e.g., Mauss, McCarter, Levenson, Wilhelm, & Gross, 2005), emotion concordance (e.g., Hollenstein & Lanteigne, 2014) and response organisation (e.g., Levenson, 2014).

Moving beyond theoretical considerations, early empirical work produced somewhat mixed findings. Some studies found a positive relationship between the overall frequency or intensity of experiences (e.g., amusement) and expressions (e.g., smiling) (Bonanno &

Keltner, 2004; Ekman, Freisen, & Ancoli, 1980; Ekman, Friesen, & Davidson, 1990; Gross, John, & Richards, 2000), whilst other work found weak or no relationship between similar parameters (Herring, Burleson, Roberts, & Devine, 2011; Jakobs, Manstead, & Fischer, 2001; Mehu, Grammer, & Dunbar, 2007). However, more recent and methodologically sophisticated work has consistently reported a relationship between moment-to-moment experiences and facial expressions (Brown et al., 2019; Butler, Gross, & Barnard, 2014; Mauss et al., 2005; Rosenberg & Ekman, 1994; Sze, Gyurak, Yuan, & Levenson, 2010). Taken together, there seems good reason to believe that affective experiences tend to correlate (when measured precisely and concurrently) with facial muscle activation—a view that is consistent with recent narrative and data-driven reviews of the literature (Durán et al., 2017; Reisenzein et al., 2013).

The aforementioned work also demonstrates that the relationship between affective experiences and facial expressions varies substantially from person to person (Brown et al., 2019; Durán et al., 2017; Gross et al., 2000; Mauss et al., 2005; Sze et al., 2010). Although there has been little formal theorizing as to what may account for this variability, some common explanations are present in the literature. The first is that coherence is moderated by the extent to which people are prone to inhibit their facial expressions (Brown et al., 2019; Butler et al., 2014; Dan-Glauser & Gross, 2013; Matsumoto & Kupperbusch, 2001; Mauss et al., 2005; Rosenberg & Ekman, 1994); for example in the context of attempting to regulate experiences (e.g., Gross, 2015) or as a function of socio-cultural differences (e.g., Matsumoto, 1990). The idea here is that attempting to regulate one's expressions alters facial muscle activation but leaves experiences relatively unchanged (e.g., Gross & Levenson, 1993), and should therefore disrupt coherence. A second idea is that coherence can be increased by focusing on relevant affective information. Here it is argued that the way we access and interpret affectively-relevant cues (e.g., bodily states) is a central predictor of how an emotion-programme will unfold (see also Damasio, Everitt, & Bishop, 1996; Niedenthal, 2007). According to this view, people who are more focused and aware of their internal states ought to show greater correspondence between their experiences and facial expressions, compared to those who are less focused and aware (e.g., Rosenberg & Ekman, 1994; Sze et al., 2010).

Although empirical data on underlying processes is sparse, these ideas do find some support in the literature. Facial displays are less reliable indicators of affective experiences in those who are chronically inclined to inhibit their expressions (Gross et al., 2000). Moreover, asking people to actively suppress their facial expressions disrupts the coherence between moment-to-moment experiences and facial muscle activation (Butler et al., 2014; Dan-Glauser & Gross, 2013). Studies examining differences between people further demonstrate that those who likely have a higher level of body-awareness (e.g., meditators) show greater moment-to-moment coherence between their experiences and expressions (in this case heart rate) than those who likely have a lower level of body-awareness (e.g., controls; Sze et al., 2010).

Taken together, there is converging theoretical and empirical work pointing to the fact that people who are disinhibited and/or more attuned to internal states seem to present with greater coherence than those who do not. However, what remains somewhat unclear is how these differences map onto the social world. Who should we expect to have higher versus lower disinhibition and/or be more versus less attuned to internal states, thus presenting with greater coherence? Drawing on the extant social psychology literature, we contend that people who enjoy elevated social power—defined here as asymmetric control over valued resources (Fiske & Dépret, 1996)—are more likely to exhibit disinhibition and an awareness of internal states and, by implication, are therefore more likely to display coherence.

Several theoretical accounts posit that power is associated with greater disinhibition and self-expression (Guinote & Chen, 2018; Hirsh, Galinsky, & Zhong, 2011; Keltner, Gruenfeld, & Anderson, 2003; Rucker & Galinsky, 2016). For example, power is widely theorised to reduce inhibition and response conflict by affording access to rewards (Keltner et al., 2003) and reducing social concerns (Hirsh et al., 2011). More recent complementary theoretical perspectives suggest that power enhances activation and expression of features of the self (Guinote & Chen, 2018) and reduces the importance of others (Rucker & Galinsky, 2016), giving rise to self-concept consistency and feelings of authenticity (Kraus, Chen, & Keltner, 2011)

Supporting the proposed link between power and disinhibition, studies show that powerholders are more inclined to express their opinions and feelings to others (Berdahl & Martorana, 2006; Chen, Langner, & Mendoza-Denton, 2009; Dovidio & Ellyson, 1985; Hall, Coats, & LeBeau, 2005); perhaps because they are less preoccupied with social norms compared to less powerful individuals (Diefendorff, Morehart, & Gabriel, 2010; Moon, Weick, & Uskul, 2018). Consistent with this reasoning, powerholders seem particularly comfortable in expressing negative affect compared to their powerless peers (Petkanopoulou, Rodríguez-Bailón, Willis, & van Kleef, 2019). Moreover, this seems to reflect a general tendency towards disinhibition, as opposed to a specific disregard for social constraints. For example, powerholders are more likely to manifest their desires by rearranging their immediate environments (Galinsky, Gruenfeld, & Magee, 2003) and are less inclined to regulate their experiences via suppression (Petkanopoulou, Willis, & Rodríguez-Bailón, 2012) —a strategy that is adopted spontaneously and also in the absence of others (e.g., Ehring, Tuschen-Caffier, Schnülle, Fischer, & Gross, 2010).

Meanwhile, the notion that powerholders are more attuned to internal states aligns with work showing that power increases interoceptive accuracy—the ability to perceive bodily signals (Moeini-Jazani, Knoeferle, de Molière, Gatti, & Warlop, 2017). Furthermore, compared to individuals with a weaker sense of power, individuals with a stronger sense of power report experiencing greater clarity in their feelings in general ([AUTHORS], *under review*), and in feelings associated with moral issues, fostering more unequivocal punitive actions (Wiltermuth & Flynn, 2013). As a corollary of this heightened awareness of internal states, powerholders' judgments are also more strongly guided by feelings (Weick & Guinote, 2008) and perceived physiological arousal (Jouffre, 2015). Taken together, there is converging evidence that power makes people more attuned to internal states, both in terms of increasing access to internal signals, and using those signals to guide judgments and actions.

Since power fosters disinhibition and makes people more attuned to internal states, it stands to reason that elevated power may increase the coherence between self-reported affect and outward facial expressions. This is consistent with the aforementioned study by Jouffre (2015) who observed a stronger association between (bogus) physiological arousal and judgements of attractiveness in powerful compared to powerless and control participants. Other studies have found a stronger correspondence between circadian rhythm and self-reported mood (Leach & Weick, 2018, Study 2), and between eye- and hand-movements and self-reported liking (Woltin & Guinote, 2015) in powerful compared to powerless and control participants.

While the aforementioned studies show that power can modulate the correspondence between bodily states and self-reports, studies that are more pertinent to the present research question by looking specifically at the link between power and coherence in facial expressions have yielded no conclusive results. In one study, low power (*vs.* baseline/control) reduced the correspondence between facial expressions and self-reported affect (Hecht & LaFrance, 1998), consistent with predictions. However, this effect did not emerge in later conceptual replication studies (Hall & Horgan, 2003). Furthermore, contrary to our predictions, none of the studies conducted so far found any evidence that high power (*vs.* baseline/control) increased the correspondence between facial expressions and self-reported affect (Hall & Horgan, 2003; Hecht & LaFrance, 1998).

We believe it is important and timely to revisit these earlier studies on power and coherence in facial expressions for several reasons. First of all, as discussed, there are strong theoretical grounds to assume that power modulates the correspondence between facial expressions and self-reported affect. Previous studies by Hall and Horgan (2003) as well as Hecht and LaFrance (1998) could be considered outliers when viewed in the context of the wider literature on power and subjective experiences (Berdahl & Martorana, 2006; Dovidio & Ellyson, 1985; Guinote, 2010; Jouffre, 2015; Leach & Weick, 2018; Moeini-Jazani et al., 2017; Petkanopoulou et al., 2019; Weick & Guinote, 2008; Woltin & Guinote, 2015). Incongruent findings arising from different research traditions are hampering theory development, and we need to know if power impacts coherence in facial expressions.

Second, previous studies on power and coherence in facial expressions employed a single methodology, and a multi-method approach seems warranted before any firm conclusions can be derived from these studies. In particular, Hecht and LaFrance (1998) and Hall and Horgan (2003) assigned participants to equal or unequal power roles and then examined the correspondence between smiling and self-reported affect (happiness) during dyadic interactions. Smiling was assessed through observer codings—a technique that may not capture more subtle facial expressions to the same extent as direct physiological measures (Fridlund & Cacioppo, 1986; Tassinary & Cacioppo, 1992). Happiness was assessed through retrospective self-reports (e.g., "*during the interaction I felt…*"), which can suffer from memory distortions and response biases (Barrett, 1997). All studies focused on a single facial expression (smiling) and relied on single measures of the dependent variables, which some have argued is not a viable approach to examine correspondence between outcomes (Mauss et al., 2005; Stemmler, 1992).

All in all, there is good reason to revisit the question whether social power impacts the correspondence between self-reported affect and facial expressions. In approaching this question, we address a number of shortcomings in the literature by measuring self-reported affect repeatedly over a period of time whilst exposing participants to negative, neutral, and positive stimuli, by using electromyography to provide a more sensitive measure of facial expressions, and by capturing both smiling and frowning responses to examine if any effects of power generalise to different facial expressions. Finally, unlike previous studies, we examine facial expressions exhibited in a private setting, thereby reducing sources of (co)variation arising from participant interactions, creating optimum conditions to capture the effects of (high and low) power on coherence. Based on the rationale outlined earlier, we hypothesised that elevated power will strengthen, and impaired power weaken, the positive association between self-reported affect and smiling (+smile↔ +affect), and the negative association between self-reported affect and frowning (+frown↔ - affect).

Methods

Participants and Design

One-hundred and ninety-three students from a British University participated in exchange for course credits. Eleven participants were excluded; due to equipment error (*n* = 5), identifying the aim of the study (*n* = 4; see also Table S1) or requesting to prematurely end the study (*n* = 2), leaving a final sample of 182 participants (138 female; M_{age} = 19.68, *SD* = 3.05).[1] The sample size provided approximately 80% power at α = .05 to detect a small-to-medium sized effect.[2] Participants were randomly assigned to one of three power conditions (low *vs*. baseline *vs*. high) using an algorithm to determine the order of a set number of conditions.

Procedure and Materials

On arrival at the lab, participants were seated individually in a temperature controlled room (~22°C). Participants completed the study in private with only a voice intercom system used to communicate with the experimenter. After connecting the physiological monitoring system (described below) the experimenter left the room and all instructions were provided in written format on a computer screen and via pre-recorded messages played on a sound system. Participants were led to believe they would engage in a group task with a second participant. We employed a standard manipulation of actual power whereby participants were either informed that they would have a Director position (high power) or a Member position (low power) in a team exercise. Directors had direct access to rewards whilst being able to control Members' access to rewards (lottery tickets for a £50 draw). In contrast, Members' access to rewards was dependent on the Directors (see Guinote, 2007, for further details). No roles or rewards were mentioned to participants in the baseline condition, who also expected to participate in a team exercise. After receiving instructions, all participants indicated how much *control* and *influence* they had in the team exercise (1 = *not at all,* 9 = *very much*). These two items served as manipulation checks. Participants were then asked to complete a seemingly unrelated task whilst allegedly waiting for their partner.

Participants reported their affect in response to forty-eight images selected from the International Affective Picture System [IAPS] (Lang, Bradley, & Cuthbert, 2008); positive (i = 16, M = 7.55, SD = 0.54), negative (i = 16, M = 2.37, SD = 0.55) and neutral (i = 16, M = 5.04, SD = 0.19) images (see Table S2 and S3). Each image was presented for six seconds and followed by a Self-Assessment Manikin (SAM)—a pictorial self-report measure of affect (Bradley & Lang, 1994) ranging from 1 (*sad*) to 9 (*happy*; see also Supplemental Materials for further discussion).[3] A randomised inter-trial interval of 12 to 18 seconds allowed physiological responses to return to baseline (Fridlund & Cacioppo, 1986). Image presentation was randomised, with the constraint that no more than two images of the same hedonic valence were presented consecutively. After the image task, participants were probed for suspicion and debriefed. All participants were given an equal chance to win a £50 cash prize.

Apparatus

Physiological data were acquired using BIOPAC MP150 (BIOPAC Systems, Santa Barbara, CA). Electric potentials were sampled at 2000Hz throughout the entire study, via Ag-AgCl electrodes filled with NaCl gel, placed on the Zygomaticus (right cheek) and Corrugator (right brow; for exact placement see Fridlund & Cacioppo, 1986). Raw EMG signals were filtered (High: 10Hz; Low: 500Hz) and then amplified (x5000).[4]

Results

Data Preparation

Physiological data were processed off-line using AcqKnowedge Software (Version 4.1). EMG signals (measured in μV) were rectified (Fridlund & Cacioppo, 1986). Average EMG amplitudes in the one second before each image presentation were subtracted from the average amplitudes whilst image-viewing, separately for each trial. Amplitudes were then winsorised by replacing extreme values (+/- 2.5SD) with the next highest value in the distribution for each individual participant, and then standardised. Continuous self-reports were likewise standardised for the main analysis reported below so as to obtain standardised coefficients that are akin to an effect size (see Ferron, Hogarty, Dedrick, Hess, Niles, & Kromrey, 2008; Nezlek, 2012). The interpretation of the resulting coefficients is the number of standard deviations by which Y (the outcome variable) is expected to increase or decrease as a result of a standard deviation change in the predictor (for continuous variables) or by moving from one group or condition to another (for categorical variables). Lastly, composite scores were calculated for the two manipulation-check items measuring power ($r = .76$, $M = 5.40$, $SD = 2.06$).

Manipulation Check

Power. High-power participants felt more influential and in control ($M = 7.51$, $SD = 1.17$) than baseline participants ($M = 5.06$, $SD = 1.07$), $t(121) = 12.12$, $p < .001$. Similarly, low-power participants felt less influential and in control ($M = 3.54$, $SD = 1.51$) than baseline participants, $t(119) = 6.37$, $p < .001$. Thus, the role assignment successfully induced feelings of power and powerlessness.

Image Valence. The images successfully influenced participants' self-reported affect and facial expressions. As shown in Table 1, participants reported more positive affect and smiled more towards positive images, and more negative affect and frowned more towards negative images, compared to neutral images.

Insert Table 1

Main Analysis

The aim of our analysis was (a) to probe associations between facial expressions and self-reported affect for all experimental conditions (akin to simple effects), and (b) to establish any significant differences in the strengths of the associations between power conditions (akin to moderations). To avoid pitfalls associated with aggregating data, we took a multi-level approach fitting two random intercept and slope models to the standardised affect data (i=8832), one for each expression (smile and frown; descriptive statistics are provided in Supplemental Materials, Table S4). In these regression-based models, mean-differences between participants and stimuli were modelled with random intercepts, whilst variations across images of differing valence (within participants) were modelled with random slopes. Fixed effect coefficients modelled variations in zygomaticus (smile) or corrugator (frown) activation, respectively, and dummy coefficients compared high (D1=1, D2=0) and low (D1=0, D2=1) power with baseline, and positive (D3=1, D4=0) and negative (D3=0, D4=1) images with neutral images. All interactions were included in the models (see Tables S5-S16 for full variance estimates).

Since the work reported here encompasses a single study and, as discussed earlier, previous studies have failed to observe key hypothesised effects, we use a more stringent *p*-value as a criterion to reject the null hypothesis (Lakens et al., 2018). In particular, following recent recommendations we use $p \leq .005$ (0.5%) as a threshold for statistical significance (Benjamin et al., 2018). We interpret effects that do not cross this stringent threshold but would normally be considered statistically significant ($p \leq .05$) as suggestive but not fully conclusive. In addition, we apply the Benjamini-Hochberg procedure to ensure that the aforementioned critical thresholds remain intact when conducting multiple statistical tests / comparisons (Benjamini & Hochberg, 1995). Thus, we take several steps to ensure that we do not overstate the evidential value of the present findings.

Confirmatory analysis. To achieve our first aim to probe the relationship between facial expressions and self-reported affect at each level of power (low, baseline, high) and for each image type (negative, neutral, positive), we re-ran the models whilst changing the reference category represented by the dummy coefficients to probe different simple effects (for the exact coding scheme see Tables S5-S16). In these models, *smile* coefficients provide estimates of the correspondence between self-reported affect and zygomaticus activation towards neutral and positive images, respectively, and *frown* coefficients provide estimates of the correspondence between self-reported affect and corrugator activation towards neutral and negative images, respectively (see Tables S5-S16 for full variance estimates).[4]

Table 2 displays the aforementioned associations between frowning and smiling, respectively, in experimental conditions. As can be seen, in baseline and low power participants, smiling was associated with self-reported positive affect when viewing positive images, $p\text{s}_{BHadj} < .001$, but frowning was not associated with self-reported negative affect when viewing negative images, $p\text{s}_{BHadj} \geq .654$. In high power participants, smiling also correlated with self-reported positive affect when viewing positive images, $p_{BHadj} < .001$. However, in contrast to low power and baseline participants, frowning also correlated with ratings of negative affect when viewing negative images in high power participants, $p_{BHadj} < .001$.

Turning to our second aim to compare associations between conditions, we examined the interaction between smiling and power, and frowning and power, respectively (not shown in Table 2, hence reported fully here). Relative to baseline participants, high power increased the association between smiling and self-reported positive affect, $\text{coeff}_{D1xSmile} = 0.06$, SE = 0.02, 95% CI [0.02, 0.09], $p_{BHadj} = .005$. There was some indication that high power may have also increased the association between frowning and self-reported negative affect, $\text{coeff}_{D1xFrown} = -0.07$, SE = 0.03, 95% CI [-0.13, -0.01], $p_{BHadj} = .044$, but the evidence was not conclusive. Unexpectedly, low power participants did not differ from baseline participants, $\text{coeff}_{D2xSmile} = 0.04$, SE = 0.02, 95% CI [0.00, 0.07], $p_{BHadj} = .087$ and $\text{coeff}_{D2xFrown} = -0.01$, SE = 0.03, 95% CI [-0.07, 0.05], $p_{BHadj} = .818$.

Insert Table 2

Exploratory analysis. In a series of further exploratory analyses, we sought to establish whether the differential associations observed between low, baseline, and high levels of power could be explained by overall mean-level differences in self-reported affect and in facial muscle activation, respectively (descriptive statistics are provided in Supplemental Materials, Table S4). To that end, we fitted multi-level models to the data (see Tables S17-S20 for coding scheme and full variance estimates), which yielded no evidence that high (*vs.* baseline) power or low (*vs.* baseline) led to overall mean-level differences in self-reported affect or in facial muscle activation, $p\text{s}_{\text{BHadj}} \geq .167$. Consequently, overall mean-level differences in self-reported affect or in facial muscle activation cannot account for the differential associations observed in the present study.

Critical readers will note that we did not examine zygomaticus activation (smiling) in response to negative images and corrugator activation (frowning) in response to positive images. We did not consider these physiological responses to be relevant. Indeed, as noted earlier, manipulation checks indicated that it was rare for participants to smile in response to negative images, and to frown in response to positive images, as one might expect. Nevertheless, for completeness, we repeated the above analyses, this time also examining atypical physiological responses. As can be seen in Tables S21-26, when viewing negative images, there was no evidence that smiling was associated with self-reported affect across different levels of power, $p\text{s}_{\text{BHadj}} \geq .635$. Similarly, when viewing positive images, frowning was also not associated with self-reported affect in low power and baseline participants, $p\text{s}_{\text{BHadj}} \geq .326$. However, there was an indication that the more high power participants frowned, the more they may have been inclined to rate their affective experiences negatively, $\text{coeff}_{\text{Frown}} = -0.09$, SE = 0.04, 95% CI [-0.17, -0.02], $p\text{s}_{\text{BHadj}} = .035$, in general agreement with our hypotheses. However, the evidence for this effect was tentative and high power participants did not differ from baseline participants, $\text{coeff}_{\text{D1xFrown}} = -0.05$, SE = 0.05, 95% CI [-0.14, 0.04], $p_{\text{BHadj}} = .425$. All in all, an analysis of atypical physiological responses neither refuted nor supported the proposition that power modulates the correspondence between facial expressions and self-reported affect.

As a way of conducting a sensitivity analysis, we also re-ran all confirmatory analyses, this time omitting all fixed effects denoting different image types (negative, neutral, positive; see Tables S27-S32). In other words, we sought to explore whether high power increased, and low power reduced, the correspondence between facial expressions and self-reported affect across all images viewed. The analyses revealed that smiling was associated with more positive self-reported affect in all experimental groups (low power, baseline, high power), $ps_{\text{BHadj}} < .001$. However, frowning was only associated with self-reported affect (negatively—as expected) in high power participants, $p_{\text{BHadj}} < .001$, but not in low power and baseline participants, $ps_{\text{BHadj}} \geq .541$. Comparing associations between conditions, high power increased the association between smiling and self-reported affect relative to baseline participants, $\text{coeff}_{\text{D1xSmile}} = 0.05$, SE = 0.01, 95% CI [0.02, 0.08], $p_{\text{BHadj}} = .002$. Furthermore, there was some indication that high power increased the association between frowning and self-reported negative affect, $\text{coeff}_{\text{D1xFrown}} = -0.06$, SE = 0.02, 95% CI [-0.10, -0.01], $p_{\text{BHadj}} = .017$, but once again the effect did not meet our stringent criteria for significance and was therefore deemed inconclusive. Unexpectedly, there was an indication that low power may have *increased* the association between smiling and self-reported negative affect, $\text{coeff}_{\text{D1xSmile}} = 0.04$, SE = 0.01, 95% CI [0.01, 0.07], $p_{\text{BHadj}} = .011$, but the evidence was also inconclusive. Finally, there was no evidence that the correspondence between frowning and self-reported affect differed between low power and baseline participants, $\text{coeff}_{\text{D1xFrown}} = 0.01$, SE = 0.02, 95% CI [-0.02, 0.04], $p_{\text{BHadj}} = .622$. All in all, sensitivity analyses confirmed that the conclusions derived from the present study hold when data are not broken down by image type (negative, neutral, positive).

Discussion

Sampling self-reported affect and recording facial muscle activity via electromyography concurrently in response to negative, neutral, and positive stimuli, we found evidence that *high* power (*vs.* baseline) *increased* the correspondence between smiling and self-reported affect, consistent with predictions. We also found evidence that frowning was associated self-reported affect in high power participants but not in low power and baseline participants. However, there was not enough evidence to affirm that the association between frowning and self-reported affect was stronger in high power participants compared to baseline participants. All in all, the present findings support the assumption that high power (*vs.* baseline) can impact the correspondence between facial expressions and self-reported affect, but it remains to be seen whether this effect extends from smiling facial expressions to frowning facial expressions.

Unexpectedly, we did not find any evidence that low power (*vs.* baseline) dampened the correspondence between facial expressions and self-reported affect. In particular, we found no evidence that frowning was associated with self-reported affect in either low power or baseline participants. Furthermore, smiling tended to be somewhat more strongly related to self-reported affect in low power compared to baseline participants, contrary to our predictions. However, evidence for a differential association did not emerge consistently and when it emerged the evidence was inconclusive. All in all, it seems prudent to constrain our conclusions to the assertion that the data failed to support the research hypothesis that low power reduces coherence in facial expressions.

Differences in research design could explain why prior research did not consistently observe an effect of power on coherence in facial expressions (Hall & Horgan, 2003; Hecht & LaFrance, 1998). These previous studies employed between-subject designs, relied on single measures of the dependent variables, and drew on observer ratings to code facial expressions. In contrast, in the present research we measured self-reported affect repeatedly over a period of time whilst exposing participants to negative, neutral, and positive stimuli. Coupled with using repeated measures that are more reliable than single measures, we also sought to capitalise on the high temporal and spatial resolution of electromyography to capture subtle facial expressions (Tassinary & Cacioppo, 1992). A corollary of the different designs is that previous studies focused solely on explaining variation between participants, whereas the present study examined variation between *and* within participants. Note that because different studies examined different sources of variation, it would not be appropriate to apply meta-analytic techniques to identify overarching trends.

As noted earlier, only Hecht and LaFrance (1998) found an effect of low power on the correspondence between facial expression and self-reported affect, which did not emerge in later studies. Participants in Hecht and LaFrance’s study took part in a mock interview playing the roles of interviewer (high power) and applicant (low power), respectively, for a research position at a prestigious medical school and a (real) chance to win $100. Applicants had to discuss their personal experience and training as psychology student to make a case for their suitability for the post. It is conceivable that this setting elicited a high degree of impression management in low power participants, thereby reducing the association between smiles and self-reported experiences (Knight & Mehta, 2017). Hall and Horgan’s (2003) studies did not involve any monetary incentive, low power participants did not have to disclose any personal information, and low and high power participants worked together on a task that was very enjoyable for all parties involved (as suggested by the high levels of positive affect reported by participants in all conditions). In the present study, we took a different approach assessing participants’ responses during a more mundane task performed in private, thereby reducing or indeed eliminating the need for low power participants to engage in impression management.

Strengths and Limitations

It is worth pointing out some notable strengths of the present study. Unlike previous studies in this line of research, we adopted a modern approach by sampling both participants and stimuli, thereby enhancing the generalisability and potential robustness of our findings (Judd, Westfall, & Kenny, 2012). In addition, we followed recent recommendations to adopt a more conservative threshold for statistical significance (Benjamin et al., 2018). We deemed this necessary because the present research encompasses a single study whilst testing some predictions that were not supported in previous investigations (cf. Lakens et al., 2018). We also sought to isolate the effects of low and high power through comparisons with a baseline condition, thereby extending previous studies that focused on the comparison between low and high levels of power (Guinote, 2010; Moeini-Jazani et al., 2017; Weick & Guinote, 2008). The inclusion of a baseline condition proved crucial as it transpired that the effects of low and high power were asymmetric.

We followed a well-established, standard procedure to manipulate different levels of power, which entailed giving participants actual control over outcomes (high power), or having their outcomes controlled by another person (low power; see Anderson & Berdahl, 2002; Fiske & Dépret, 1996; Guinote, 2007, 2008; Lammers, Stapel, & Galinsky, 2010). This approach is arguably more controlled than alternative manipulations (e.g., episodic priming) as it does not rely on participants beliefs about power, which vary and can be idiosyncratic (e.g., Torelli & Shavitt, 2010). That said, power is a complex, multi-faceted construct, and based on the results obtained in one study we cannot be certain that our results generalise to all manifestations of low and high power. For example, in some circumstances power can be construed as responsibility, and studies show that this can disrupt or even reverse many of the effects of power reported in the literature (Lammers, Stoker, & Stapel, 2009; Sassenberg, Ellemers, & Scheepers, 2012; see also Leach, Weick, & Lammers, 2017). On a related note, the way in which people perceive and respond to having and lacking power can differ greatly between cultures (e.g., Moon et al., 2018; Torelli & Shavitt, 2010). Thus, it remains unknown whether the present findings generalise to different cultural settings.

An important limitation of the present research is that we can only speculate about underlying processes. Recall that our predictions were couched in terms of differences in disinhibition and in attunement to internal cues. If disinhibition were the mechanism underlying our results, one could speculate that high power should increase, and low power should reduce, the overall amount of facial muscle activation.[5] However, we found no evidence that power impacted participants' smiling or frowning expressions per se; only the *correspondence* between (some) facial expressions and self-reported affect was altered. This could indicate that differences in disinhibition are unlikely to account for the present findings. If true, this would narrow the number of possible underlying processes, but we still do not know whether the effects of (high) power can be attributed to a greater attunement to internal cues. Evidently, further research is needed to explore the precise mechanisms through which power impacts the coherence between affect and expression.

It is also important to note that even though associations between facial expressions (smiling) and self-reports were significant for high power participants, effect sizes were small. This could be due to the experimental setting and repeated nature of the assessment. Either way, it is worth putting our findings into the context of typical effect sizes in personality and social psychology, which range from $r = .11$ (small) to $r = .29$ (medium) and are therefore not dissimilar (Gignac & Szodorai, 2016). Perhaps more importantly, as Funder and Ozer (2019) recently argued, when occasions accumulate over time or in a large sample small effects can be consequential. Power differentials are ubiquitous in everyday life (Smith & Hofmann, 2016), and as such there is ample opportunity for effects of power to manifest. Similarly, facial expressions are extremely prevalent and occur with a very high frequency during conversations (e.g., Turkstra, Ciccia, & Seaton, 2003). As such, conditions are ripe for occasions to accumulate over time and in large samples. Still, the small and in many cases unreliable associations between facial expressions and self-reports do call for a note of caution and echo Hess and colleagues (2017) who observed considerable variation in people's facial responses to affective cues (albeit using different affective stimuli).

Implications

Previous studies have shown that power modulates the correspondence between (bogus) physiological arousal and self-reported attraction (Jouffre, 2015), between eye- and hand-movements and self-reported liking (Woltin & Guinote, 2015), and between circadian rhythm and self-reported mood (Leach & Weick, 2018). Consistent with these studies, we found (some) facial expressions to be more strongly aligned with self-reported affect in a sample of high power (*vs.* baseline) participants. This finding ties in well with the notion that experiences are an important driver of powerholders' thoughts and actions (Weick & Guinote, 2008), and dovetail a body of work showing that powerholders may transmit more easy-to-read non-verbal signals (Hall, Rosip, LeBeau, Horgan, & Carter, 2006). From an evolutionary perspective, more unequivocal signalling by higher ranking individuals may reduce intra-group frictions (Keating, 1985).

It is interesting to note that low-power and baseline participants did not express negative affect consistently in the present study, showing little correspondence between self-reports and facial expressions. One could speculate that this may be due to the fact that displays of negative affect are often discouraged (Matsumoto, 1990), and this may lead people to regulate their negative experiences by not expressing them (even in private, if suppression is an automatic, habitual response); a strategy that is unlikely to be effective (Gross & John, 2003). A corollary of this is that it may be more difficult for observers to infer negative affective states relative to positive affective states from other people's non-verbal signals (unless the observational target has high power, although this qualification requires further research).

The social psychological literature often focuses on mean-level differences in positive and negative affect when describing the affective lives of powerful and powerless individuals (Keltner et al., 2003). However, emerging evidence suggests that this approach is overly simplistic and does not take into account how power shapes people's experiences across context and time. In particular, there is evidence that powerful individuals only experience more positive affect than powerless individuals in pleasant contexts, but not in unpleasant contexts (Leach & Weick, 2018). As a corollary, high power increases, and low power reduces, variability in mood between contexts and also across time, in part because power is associated with more effective affect regulation (Leach & Weick, *under review*). Coherence, variability, and affect regulation are each associated with differences in wellbeing (Brown et al., 2019; Ehring et al., 2010; Gross & John, 2003). The present work calls for further research into how power alters affect-related processes, moving beyond current approaches that focus solely on mean-level differences in positive and negative affect.

The present findings also have implications for the wider literature on emotion coherence. This literature has put an emphasis on demonstrating the existence of coherence (e.g., Mauss et al., 2005), probing the mechanisms underlying coherence (Sze et al., 2010) and examining the adaptive benefits of coherence (Brown et al., 2019). Evidence for predictors of emotion coherence remains sparse, with extant studies often focusing on relatively small segments of the population. For example, dancers and meditators appear to enjoy greater emotion coherence compared to controls (Sze et al., 2010). In other words, not much is known about who is likely to exhibit greater, and lesser, coherence in the population at large. Our data extend this literature by pointing to a salient social construct that permeates all aspects of social life, and which appears to play some role in determining who enjoys greater, and lesser, coherence.

Conclusion

We found evidence that power impacts the correspondence between positive affect and smiling, broadly in agreement with Hecht and LaFrance (1998), but challenging Hall and Horgan's (2003) conclusions. Extending previous studies, we observed a small effect of *high* (*vs.* baseline) power on the correspondence between smiling and self-reported affect. However, it remains to be seen whether this effect also extends to frowning responses. All in all, the findings underscore the importance of social power as a factor that can impact the expression of internal states.

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Footnotes

[1] Inclusion of suspicious participants did not impact the conclusions drawn from the analyses.

[2] As discussed more fully in the General Discussion, previous studies examined different sources of variation, and as such do not provide a strong basis for an *a priori* power-analysis. In addition, since the cumulative moderating effects of low and high power observed in Hall and Horgan (2003) and Hecht and LaFrance (1998) are, essentially, zero (*r*s = .29 vs. .30), it would not be possible to devise a study that can reject the null hypothesis with a likelihood of .80 (1-β) or higher. Consequently, we put aside the effect sizes observed in previous studies and instead aimed to detect a meaningful effect with a sufficient level of statistical power.

[3] Participants also reported their arousal from *1* (*calm*) to *7* (*excited*; Bradley & Lang, 1994). As noted earlier, we focus on facial expressions as a relatively unambiguous marker of affect. Our primary interest in affective valence is reflected in the selection of stimuli (i.e., images), which differed systematically on valence (negative *vs.* neutral *vs.* positive) but not on arousal (low *vs.* high).

[4] Cardiac activity and skin conductance were also recorded via Ag-AgCl electrodes, placed on the right forearm and left leg, and second and third digit of the right hand. The present research focuses on non-verbal expressions of affect, and as such cardiac activity and skin conductance are not discussed further.

[5] We thank an anonymous reviewer for pointing this out.

Table 1.

Self-reported affect, smiling and frowning in response to different images (negative, neutral, positive).

	Image Valence			
Measure	Negative	Neutral	Positive	Valence main effect
Affect (Self-Report)	$2.70_a(0.95)$	$5.12_b(0.52)$	$6.76_c(0.75)$	$F(2, 362) = 1190.44$, $p < .001$, $\eta_p^2 = .87$
Zygomaticus (Smile) activation (std. μV)	$-0.17_a(0.21)$	$-0.11_a(0.28)$	$0.28_b(0.92)$	$F(2, 362) = 37.33$, $p < .001$, $\eta_p^2 = .17$
Corrugator (Frown) activation (std. μV)	$0.11_a(0.37)$	$-0.06_b(0.38)$	$-0.05_b(0.57)$	$F(2, 362) = 7.20$, $p = .001$, $\eta_p^2 = .04$

NB: Observed means and standard deviations in parentheses. Higher values indicate more positive affect/greater facial muscle activation. Means not sharing a common subscript within rows are significantly different ($p < .05$).

Table 2.

Associations between facial muscle activation and self-reported affect, by expression (smile, frown), power (low, baseline, high), and in relation to different images (negative, neutral, positive).

	Negative Images				Neutral Images				Positive Images			
Expression/Power	Coeff.	SE	95% CI		Coeff.	SE	95% CI		Coeff.	SE	95% CI	
Smile (zygomaticus activation)												
Low Power	0.03_a	0.03	-0.03	0.08	0.04_a	0.03	-0.02	0.09	0.09_a***	0.01	0.07	0.12
Baseline Power	-0.02_a	0.02	-0.06	0.02	0.04_a*	0.02	0.01	0.08	0.06_b***	0.01	0.03	0.08
High Power	-0.02_a	0.03	-0.09	0.04	0.07_a*	0.02	0.02	0.11	0.12_a***	0.01	0.09	0.14
Frown (corrugator activation)												
Low Power	-0.01_a	0.02	-0.05	0.02	0.00_a	0.01	-0.02	0.02	0.00_a	0.01	-0.02	0.02
Baseline Power	-0.01_a	0.02	-0.05	0.04	0.01_a	0.03	-0.04	0.06	-0.04_{ab}	0.03	-0.10	0.01
High Power	-0.08_b***	0.02	-0.12	-0.04	-0.03_a	0.04	-0.10	0.05	-0.09_b**	0.04	-0.17	-0.02

NB: ***$p < .001$, **$p < .01$, *$p < .05$. Coefficients not sharing a common subscript within columns and within expressions (smile, frown) are significantly different ($p < .05$). See Table S5-S16 and S21-S26 for details on all variance estimates.